SPECTROSCOPIC BINARIES.—A number of newly discovered spectroscopic binaries are discussed briefly in No. 3, vol. xxix., of the *Astrophysical Journal*. Prof. Campbell reports that, in the course of the regular observing programme with the Mills spectrograph, the following eleven stars have been shown to have variable radial velocities:—γ Persei, ξ Tauri, θ^2 Tauri, *l* (53) Eridani, ζ Aurigæ, ρ Orionis, β Canis Majoris, ν Draconis, 70 Ophiuchi, 111 Herculis, and φ Cygni. Of these, γ Persei and *l* Eridani probably have long, whilst θ^2 Tauri and β Canis Majoris probably have short, periods, and 70 Ophiuchi is a well-known double star with a period of eighty-eight years.

As the result of the recent investigations of the D. O. Mills expedition to Santiago, Chile, Dr. Heber D. Curtis announces that five stars, ζ Canis Majoris, τ Puppis, *o* Velorum, *d* Carinæ, and *q* Velorum, have been shown to be spectroscopic binaries, the first four probably having long periods. Two other stars, ν Puppis and ν Octantis, also photographed at Santiago, are announced by Prof. W. H. Wright as spectroscopic binaries.

HARVARD COLLEGE OBSERVATORY.—Prof. Pickering's report of the work performed at the Harvard College Observatory during the year ending September 30, 1908, directs special attention to the large amount of publication during that period. With the help of a monetary grant from Mr. Fairchild, no fewer than six volumes of annals have been completed, the publications of the twelve months exceeding in amount those of the first thirty years of the observatory's existence. Fourteen thousand settings with the polarising photometer related chiefly to variables of the Algol type, and will serve to determine their light-curves and epochs of minima. About thirteen hundred settings on the asteroids Iris and Eros showed that at present their light does not vary. Four thousand one hundred stellar photographs were taken at Cambridge and 3509 at Arequipa during the year, and numerous nebulæ, stars with peculiar spectra, six meteor trails, and many variable stars were thus discovered.

THE PERCY SLADEN TRUST EXPEDITION TO THE INDIAN OCEAN.

FINAL EXPLORATIONS.[1]

THE field work of the above expedition has now been completed with the return of Messrs. H. Scott and J. C. F. Fryer from the Seychelles and Aldabra on March 29. Mr. Scott has brought with him more than 40,000 insects from the Seychelles as a result of eight months' collecting. Among these are many remarkable forms, including a very large number of beetles, which will take some years to determine. The tropical rains of December and January brought out a great variety of insects not previously obtained.

Mr. Fryer spent nearly five months in Aldabra. His preliminary report, which is subjoined, is of great interest as showing the foundations on which that so-called atoll is built. Aldabra contains about fifty square miles of land, and was supposed to be a typical atoll, almost completely land-locked. It was also known for its still containing numerous gigantic land-tortoises, and for its partially peculiar avifauna. Some sand from it, which I obtained in 1905 in Seychelles, showed the presence of a considerable quantity of silica, on account of which we deemed its exploration necessary.

Mr. R. H. Rastall, who has examined some fragments of the Aldabra rocks, forwarded to me by post, writes that "they promise to be of very great petrological interest, as they consist for the most part of spherulitic and devitrified volcanic glasses."

J. STANLEY GARDINER.

I arrived in Aldabra at the end of the south-east monsoon. Owing to the extreme dryness of the season I decided to explore the island at once with regard to its geological formation, leaving its zoology and botany until the wet season.

I had four camps, *i.e.* on Michel Island, at Takamaka on Main Island, on Esprit Island, and on Picard Island, from which I examined every portion of the so-called atoll. Owing to the dense and almost impenetrable scrub there were always great difficulties, as I had everywhere to cut paths; in addition, I cleared several broad sections from the sea to the lagoon in order to get a clear idea of the sequence of the rocks and vegetation and of the relative elevations.

The nature of the ground and of its vegetation is such that the land may be divided into four somewhat irregular zones, from the lagoon outwards, as follows:—

(1) Mangrove swamp—varying in size up to nearly a mile in maximum breadth.

(2) Champignon—the surface much metamorphosed, highly crystalline, coral rock, usually with sharply defined dark portions, in which the crystals appear to be imbedded in a brown amorphous substance. It has evidently been subjected to heavy rain denudation, its surface being a mass of points and pits. The vegetation is a scrub of *Pemphis acidula*.

(3) Platin—fairly smooth, composed mainly of coral fragments and reef débris with a few shells, weathering into large flat slabs with soil accumulating in the crevices. In places are larger depressions, in which there are usually clumps of trees. The soil is guano, with a mixture of disintegrated rock. The vegetation is varied, containing numerous small bushes and trees, Pandanus, Ficus, Euphorbia, &c.; the fauna is also varied, and comparatively rich.

(4) Shore zone—largely of blown sand, with a stunted and wind-swept vegetation; large clumps of Pandanus, Tournefortia, and Scævola everywhere very numerous.

In a broad sectional clearing which I made at Takamaka, the seaward reef commences with a fissured edge, succeeded by a sand flat, the sand being bound together by beds of grass-like Cymodocea, its rhizomes greatly overgrown by Lithothamnia; the buttresses between the fissures are themselves largely covered with sand; live coral is almost absent; not far from the edge are a few small boulders of dead coral, all much encrusted with Lithothamnia; a few species of seaweed are found in the pools left at low tide. The landward edge of the reef is formed of cliffs 12 feet to 15 feet high, just outside which is usually a small depression in the reef with 2 feet or 3 feet of water. The cliffs are sloping, not overhanging, and are divided into buttresses; they consist of a mass of corals cemented together with lime. The corals are all in the position in which they grew, and so perfect that they give the impression that they are only just dead. On the landward side of the cliffs is a ridge, 2 feet or 3 feet higher, of grass-covered sand; this marks the seaward edge of the shore zone, which is about 250 yards wide, the sand being shallow and lying on a basis of coral rock. Then comes a ridge, 4 feet to 6 feet higher, the rock more solid and less denuded; this, the highest part of the section, is some 25 feet above sea-level. From the landward side of this ridge the level gradually decreases to about 10 feet above sea-level. It passes into a zone of Champignon, which here lies outside the Platin zone, which latter extends to the mangrove swamp. The Platin is all very similar in appearance, except that it is more wooded near the lagoon; it terminates with a sharp drop through the last 4 feet or 5 feet to the lagoon surface. At Takamaka there is a spring of fresh water and a grove of large Calophyllum and Ficus trees. This spring, with three others all lying between Takamaka and the lagoon, is the only constant source of fresh water on the islands. The section finishes at Abbot's Creek, which is a narrow passage from the lagoon with a thick undergrowth of mangroves on each side; its bed is rocky, and covered with very fine white mud; at its termination in the land it passes between small cliffs, all much overhung and obviously breaking down.

In another section, which passes from Vert Island in the lagoon northward to the sea, the country is all, with the exception of the shore zone, of the Champignon type, Platin being entirely absent. There is a gradual slope from the lagoon, becoming steeper at the beginning of the shore zone; right up to the latter salt water is often found in pits in the rock, fluctuating, apparently, with the lagoon tides. The cliffs on this north coast are 4 feet or 5 feet higher than those before described, and are always much overhanging. Caves penetrate far into their faces, large portions of which have at intervals fallen on to the reef; this fallen rock appears to become disintegrated quickly, as small pieces are uncommon, the action of the sea being assisted by boring animals (small Gephyreans, boring molluscs, &c.). As elsewhere round the coast, the rock shows its component corals in a way which leaves no doubt as to their being absolutely in the same position as previous to their elevation. On the reef here there are three or four distinct regions; close to the cliff there is a small belt of bare rock, often worn into hollows containing 3 feet or 4 feet of water; then a large area, mainly of broken coral fragments covered with Lithothamnia, and edged outside with a small boulder zone; and outside this, again, buttresses with a few colonies of living corals in the channels. Such are the usual features of the fringing reef at Aldabra, the appearance in the Takamaka section being quite exceptional.

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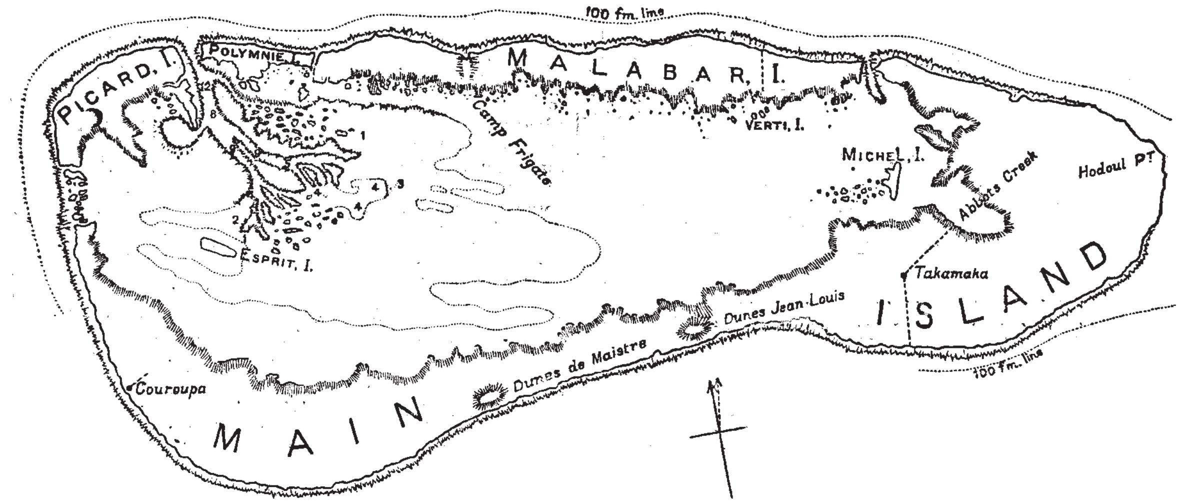
[1] For earlier reports see NATURE, April 13, August 10, October 5, November 9, December 21, 1905, January 25, 1906, and December 17, 1908.

After the previous descriptions it is possible to speak more generally of Aldabra. The cliffs, as stated, show their structure wonderfully clearly; except in the Southern Bight, where they are sloping and buttressed, they are much overhung, and are crumbling fast. The general variations in level across the land are similar; the highest point is near the sea, and there is a steady decrease in level to the lagoon.



The Aldabra Group. Scale, about 3½ miles to 1 inch.

As regards the nature of the land, all the northern portion of the atoll—Polymnie Island, Malabar Island, and the north-east part of Main Island—consists of Champignon. The south-east portion of Main Island is chiefly Platin. In the centre of the south of Main Island there is a wide shore zone, and then a belt of Champignon. To the east and west of this portion are large mounds (65 feet in height) near the shore. They are obviously wind dunes, the seaward slope being gradual with little vegetation, the landward very steep and covered with bush. Opposite each dune the cliffs have almost entirely vanished, a direct slope of sand leading up to the dune. It is noticeable that in Aldabra, as in the other islands of this part of the ocean, dunes are only formed on the coast facing the strong south-east trades. The west portion of Main Island is chiefly Champignon. At Couroupa there is a dip in the rock which appears to extend from the shore right across to the mangrove swamp; it is filled with sand, and attains a maximum depth of 8 feet.

There are two islands now left which are of peculiar importance, *i.e.* Esprit and Picard. Round the south and west of Esprit there is a ridge of rock about 30 feet high, which has been worn away in places so as to make clear its section. The ridge itself is formed mainly of a sort of brown conglomerate or pudding stone, which in one place is capped by a chalky deposit, in which there is a certain amount of flinty rock. On the south side, towards the east end of the ridge, are some large masses of dark-brown rock at sea-level. The greater part of the body of the ridge is formed of the conglomerate, but this darker rock seems to enter more into its composition at lower levels. On the sides of the ridge are pinnacles of a rough and pointed rock, which is apparently a calcareous deposit, perhaps a mollusc bed, as it is largely formed by shells. The pinnacles are only a few feet high on the outer side of the ridge, but towards the centre of the island form a series of grotesque, upstanding pillars and walls, varying up to 15 feet in height, and standing on brown conglomerate rock.

Picard Island is mainly of the typical coral-rock structure. To the south-west there is a plain of Platin country, on the east side of which is a large basin in subterranean connection with the lagoon. On the floor of this basin I found several small lumps of dark brown rock, apparently the same as on Esprit, and on its north side there is a certain amount of the same conglomerate, though the main portion of the rock is apparently calcareous; much of it is highly crystalline calcite. Some extraordinary pieces of rock were found, apparently a calcareous matrix thinly enamelled with a transparent brown substance. Bones, the teeth of sharks and rays, and the remains of other organisms at present unidentified, were numerous in the calcareous rock, and also in a rock which appears to be conglomerate of a fine texture. As at Esprit, there is also a considerable quantity of the pinnacled shell rock.

It is, of course, quite unnecessary to emphasise the interest of the above formations. It appeared to me that the whole must have been volcanic in origin, and it is to be hoped that the examination of the rocks from Esprit and Picard may furnish a clue as to the nature of the base on which Aldabra is built.

The four Passes into the lagoon are also interesting, and perhaps give a clue to its formation. They have usually deep central channels, with reefs on either side. Small rock islets are present on these reefs, and it appears certain from their existence that the Passes are steadily increasing in size, and that their reefs are really the remains of the land kept up to low-tide level by growing coral. Live coral extends for some distance into the lagoon, there being in all cases a luxuriant bed just inside the Pass. At the mouth of the Pass all corals are largely encrusted with Lithothamnia, and further seawards many are completely killed by these algæ.

Besides the existing Passes, it should be noted that there seems a likelihood of at least three more being formed—at Camp Frigate the mangrove swamp extends right through the island to the sea, and no doubt a certain amount of water already traverses the land at that point; in Polymnie Island, at one place the swamp is within 100 yards of the shore, and a Pass will probably be formed in time; at Dune Jean Louis there is only a quarter of a mile between the sea and the swamp, and if the lagoon erosion continues no doubt Main Island will be divided at this point. It is worthy of note that fresh Passes seem always to be formed by lagoon erosion, and not from the seaward side.

The lagoon itself is very shallow, and the bottom sandy in the middle, changing into fine mud as one approaches the mangrove swamp. Everywhere one is forcibly struck by the extent of the erosion in the lagoon. Judging by its maze of small islands and mushroom-shaped rocks, at least one-third, or even more, of the lagoon can be shown to have been land at one time. At spring tides the amount of fine mud carried out to sea in suspension is very large, and it is obvious that the lagoon is still growing in size. There is some difficulty in accounting for the rapid transformation of the rock into mud, as boring animals are not common; I would suggest that possibly the mangroves have some further action on the rock than merely helping to split off large pieces.

As regards the vegetation, it is impossible to say much until the specimens collected have been worked out. The mangrove swamps extend right round the lagoon sides of the islands, Rhizophora and Brugiera being the predominating genera, though there is also a large quantity of Ceriops. Rhizophora seems to require a deep mud, but Brugiera thrives better in the more rocky places and on the small islands. In the extreme east of the atoll there is a large forest of the pseudo-mangrove Avicennia. The only other fact that need be mentioned is that Esprit Island has several plants not found elsewhere, or which are common to it and Picard Island alone.

The fauna also must be left until the collections arrive and have been examined. So far as can be seen at present, it appears to be of the regular coral-island type, with such additions in the land animals as would be natural considering the large amount of land and the larger flora. It should, however, be remarked that the mangrove swamps were very disappointing in their fauna, a condition very different from that described in mangrove swamps in other localities.

Large numbers of giant land-tortoises still exist, but the problem of their distribution does not relate to Aldabra alone, as I have found their remains on Assumption and Cosmoledo, and they are also known to have occurred in nearly all the Seychelles islands, two of which, Bird and Dennis, are coralline in structure.

In conclusion, I would suggest that the reefs and islands of the Aldabra-Farquhar line present a most interesting series in the possible life of an atoll.

(a) *Astove.*—Land rim of atoll almost perfect, and mostly rocky. Only one small Pass of recent date. Lagoon exceedingly shallow, but getting rapidly deeper. Formation of another Pass proceeding.

(b) *Aldabra.*—Land rim still very perfect, and mostly rocky. Several Passes already in existence. Strong evidence of increase of lagoon at expense of land. Lagoon deeper, and at least three Passes in course of formation.

(c) *Cosmoledo.*—Land rim broken up into a series of small islands only. Most of encircling reef bare, but evidence of a former rock-cap in mushroom-shaped rocks and minute islands. A noticeable increase of sand on the island, and decrease of rock. Lagoon deeper than that of Aldabra, and more open.

(d) *Farquhar.*—Judging from your description,[1] land rim very small. Island nearly all sand, and typical coral rock very scarce. Lagoon still more open.

(e) A final or hypothetical stage may be imagined as an atoll with a considerable lagoon, without, perhaps, any land, or, if land is present, only as sand cays piled up on the reef.

J. C. F. FRYER.

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[1] Stanley Gardiner. Trans. Linn. Soc., xii., pp. 140–5.

ROAD MOTORS AND PROBLEMS CONNECTED WITH THEM.

THE "James Forrest" lecture was delivered at an extra meeting of the Institution of Civil Engineers on April 26 by Colonel H. C. L. Holden, R.A., F.R.S. The author took for his subject the road motors of the present day, and some unsolved problems connected with them. The modern era of mechanically propelled road vehicles was inaugurated with the passing of the Act of 1896. In the case of steam traction engines there has since then been no rapid progress; problems awaiting solution in this class are (a) greater economy of fuel; (b) means of condensing all or part of the water converted into steam; (c) reduction of weight and increase of adhesion surface to the road with minimum pressure per unit area on the road, without sacrifice of other qualities, including speed.

The problems regarding medium and light road motors are similar, and the author devoted most of the paper to the latter type, which includes passenger vehicles, light delivery vans, and motor-bicycles, tricycles, &c., the speed of which is limited by law to twenty miles per hour. Though by far the greater number of such vehicles are driven by petrol engines, there are others driven by steam, electricity, and combined systems; compressed air and liquid air have also been tried, but have never passed the experimental stage. It is estimated that, of the 100,000 motor-cars and cycles in use in the British Isles, more than 99 per cent. are driven by petrol engines. In spite of the great inherent advantages of the steam engine, steam-driven road motors form so small a proportion of the whole as to render it obvious that at present their advantages do not outweigh their disadvantages. For heavier goods and public passenger vehicles they may in time compete with petrol vehicles, but for private motor-cars the boiler and burner will always, in the author's opinion, handicap the system's other advantages. Electric propulsion would be ideal if a source of electricity were available which would bear comparison with petrol in weight, cost, and portability. The generation of electricity direct from the oxidation of coal or other fuel cannot be said to be impossible, and it may be actually within our reach if we only knew how and where to grasp it.

Nearly all the internal-combustion engines in use employ the Beau-de-Rochas or four-stroke cycle. Greater uniformity in the turning moment has been secured by having multiple cylinders, and at high speeds of rotation there would not appear to be much room for improvement in this respect. At the same time, individual impulses are not entirely damped out before they reach the road, and these leave their effect to a certain extent evident on the wearing surfaces of the tyres. It is difficult to see how a more uniform turning moment can be obtained with reciprocating engines. An engine of the rotary or turbine type would be effective, but no successful example at present exists. The moving parts of the engine, and also the explosion pressures on the pistons, can be balanced so perfectly by use of the double-piston type that, if the car is at rest, it is difficult to detect by eye or ear if the engine is running. The turning moment, however, cannot be balanced, and reacts on the whole car when running, especially at full power and slow speed, as when climbing a hill. A more perfect solution may be obtained at some future time, but it would necessitate the employment of an entirely different type of engine and transmission mechanism.

The use of the spray or jet carburettor has now become universal. The carburettor that will supply a constant mixture at constant pressure and temperature under all conditions of running of the engine is one problem which has yet to be solved. When to this has been added some device whereby this constant mixture shall be diluted with air to exactly the correct extent to give perfect combustion on explosion in the cylinder, then, and then only, will perfection in this matter have been reached. The whole question of carburation is very complex, and the author regards with satisfaction the fact that it has now been taken up seriously by scientific experimenters.

No universal method of ignition has been arrived at, though electricity in some form or other seems more nearly